NOTES ON ALCOHOL

BY

SIR WALTER GILBEY, Bart.

VINTON & CO., 9 NEW BRIDGE STREET, LONDON
1903

PRICE 6d.

22102235121

Published by JOHN TAYLOR, at the "Ship," in St. Paul's Churchyard, 1692

55550

NOTES ON ALCOHOL

IN

Brandy, Whisky and Rum

BY

SIR WALTER GILBEY BART.

ILLUSTRATED

VINTON & CO., 9 NEW BRIDGE STREET, LONDON, E C.
1903

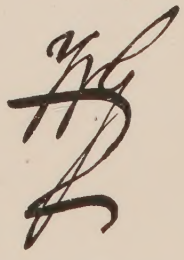
7706

WELLCOME INSTITUTE LIBRARY
Coll. welMOmec
Call No. pam WA 695 1903 G46n

PREFACE

The writer's object in compiling this brief work on Alcohol is to show its relative value in BRANDY, WHISKY *and* RUM

Alcohol is the principal component of these Spirits, but their Flavours are of such importance that any deficiency in them renders the Spirits less suitable for consumption



Elsenham Hall, Essex
November, 1903

CONTENTS

	PAGE
Antiquity of Spirit Manufacture	1
Spirit	1
Aqua Vitæ	2
Fermentation and Flavour	4
Materials yielding Brandy, Whisky and Rum ...	4
Flavour Developed by Maturing	5
Obscure Character of Flavours	5
Alcohol	7
Toxic Action of Alcohol or Plain Spirit	8
Failure of Devices to Hasten Maturing	9
Ingredients for Producing Cheap Spirit	10
Malt	10
The Process of Malting	11
Malting essential for Whisky	12
The Pot Still	17
Importance of Fire Heat	18
Patent Still and Method of Working	18
Commercial Value of Patent Spirit	19

APPENDIX

The Patent Still	21
(a) The Analyser	22
(b) The Rectifier	23
Terms denoting Strength of Spirit	28
Estimating Strength of Alcohol	28
Analyst's Method of Determining Percentage of Spirit	29
Estimating Alcohol for Fiscal Purposes	29
Suggested Standard for Alcoholic Beverages ...	31

ILLUSTRATIONS

Frontispiece	
A Pot Still, 1651	3
A Pot Still, 1692	16
Modern Pot Still	17
Patent Still	27

NOTES ON ALCOHOL

IN

Brandy, Whisky and Rum

Antiquity of Spirit Manufacture

Amongst the very oldest manufactures of the world must be placed that of producing the variety of fermented liquors which serve as more or less exhilarating beverages in various countries.

The discovery of an alcoholic liquid doubtless was due to the spontaneous fermentation of the fresh juice of fruit—probably, in the first instance, the juice of the grape.

The principal product of vinous fermentation is Spirit. This continues to be produced until it attains such proportions in the liquor that it has the effect of arresting further change. Alcoholic fermentation then practically ceases, and the Spirit so produced acts as a preservative, and becomes Nature's agent for arresting fermentative decay.

Spirit

The art of separating alcoholic spirit from fermented liquors appears to have been known in the far East from the most remote antiquity.

It is supposed to have been first known to, and practised by, the Chinese, whence a knowledge of the art gradually travelled westward.

The name "Alcohol" indicates that a knowledge of the method of preparing that substance probably came to

Western Europe, like much other chemical knowledge, through the Arabs.

In the twelfth century, when Henry II. invaded and conquered Ireland, the inhabitants were in the habit of making an alcoholic liquor called "Usquebagh" (*Uisge-béátha*, or water of life), a term since corrupted into "Whisky," which is therefore synonymous with the classical "Aqua Vitæ."

Aqua Vitæ

Whisky was first known as "Aqua Vitæ," and was originally used only as a powerful medical agent.

It was not till about the middle of the seventeenth century that it came into general use in Scotland as a stimulating beverage.

In August, 1655, the Town Council of Glasgow issued regulations for persons who should "brew, sell and tap, ail and acquavitæ," and in 1656 the town treasurer was indemnified for "aquavytie" sent to "ane friend."

A work published in 1651 contains a woodcut showing the Still in use at that period; a *fac-simile* of this drawing is given on the opposite page. The title-page of the work referred to reads as follows:—

THE ART OF

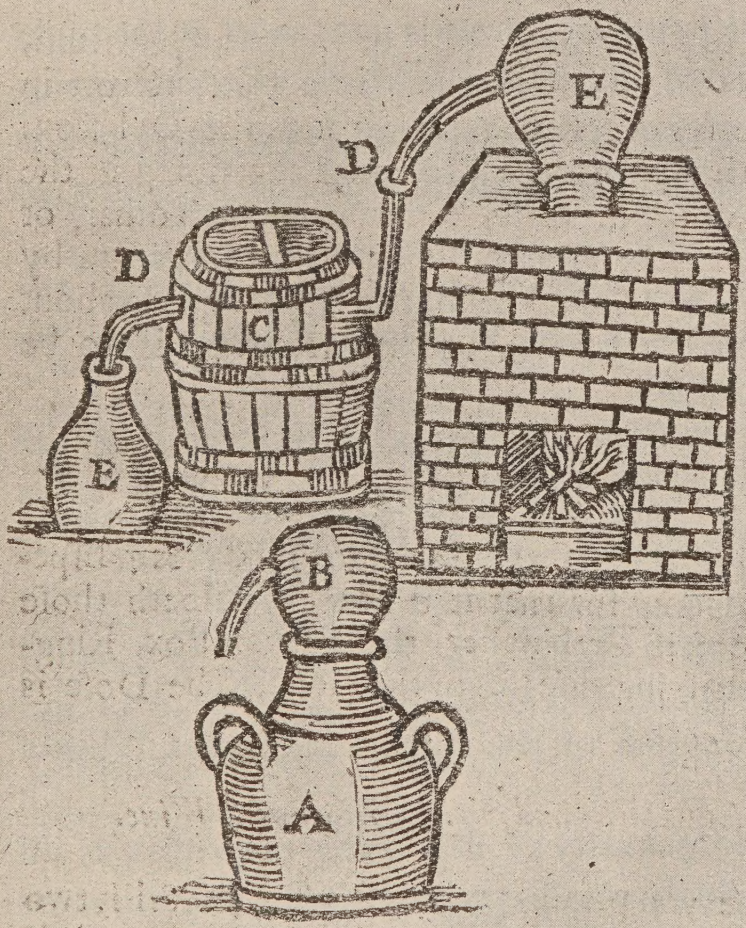
DISTILLATION

Compoſed by John French, Dr. of Phyſick

London: Printed by Richard Cotes and are to be ſold by Thomas Williams at the Bible in Little-Britain without Alderſgate, 1651.

Of the Art of Diſtillation.

A hot Still.



A, *Sheweth the bottome which ought to be of Copper.*
B, *The Head.*
C, *The barrel filled with cold water to refrigerate and condenſate the water and oyl that run through the pipe or worm that is put through it.*
D, *A pipe of braſs or pewter, or rather a worm of Tin running through the barrel.*
E, *The Alembick ſet in the furnace with the fire under it.*

How to make Aqua vitæ *out of Beer.*

TAke of ſtale ſtrong-beer, or rather, the grounds thereof, put it into a copper Still with a worm, diſtil it gently (or otherwiſe it will make the head of the Still fly up) and there will come forth a weak Spirit, which is called, low Wine: of which, when thou haſt a good quantity, thou maiſt diſtil it again of it ſelf, and there will come forth a good *Aqua vitæ*.

* NOTE.—"Aqua vitæ out of Beer" was similar to the Whisky of to-day, which is distilled from fermented wort, technically called "Ale."

Fermentation and Flavour

Alcoholic fermentation of a saccharine liquid is brought about by the operation of the living cells in the ferment involving an active re-arrangement of its component parts, which rapidly proceeds until most of the sugar present is converted into Spirit. While this conversion of the sugar continues, Flavours * are being developed in combination with the Spirit, until alcoholic fermentation at length ceases.

Further change, however, takes place between the Spirit and the Flavours, and in course of time alters the character of the liquid.

In the case of fermented grape juice, if this further change is allowed to proceed, the fragrant odour of Wine soon becomes perceptible; but if the fermented juice is at once distilled, it yields a flavoured Spirit generally described as Grape Spirit or Brandy. The same processes of change in the respective "mother liquors" result in the production of the Spirits known as Whisky and Rum.

Although the quantity of flavouring principles in all Spirit are exceedingly small compared with the amounts of Alcohol and water, they are of the utmost importance in developing the quality of the liquid.

Substances Yielding Brandy, Whisky and Rum

The fermentation of grape juice yields the Flavour in Wine; and the Wine, when distilled, is the Grape Spirit known as "Brandy."

* Many of these Flavours have been identified by the chemist as substances belonging to the group of "Esters" or Ether-like bodies.

The Malted Barley made into wort and brewed into Ale yields by distillation the spirit known as "Whisky."

The fermented infusion of the uncrystallisable sugar in the sugar-cane is a liquid from which the distiller produces "Rum."

Flavour Developed by Maturing

As the Flavours of Brandy, Whisky and Rum continue their development for a prolonged period, distillers attach great importance to the "maturing" process which gives old Spirits their character and value. For example, Grape Spirit retains the character of the fermented grape juice, which is modified by the action of time, and, in the course of years, develops the grateful aroma and agreeable taste peculiar to fine Brandy.

The quality and quantity of flavouring matter present in the Spirit, extracted by distillation from grape juice, are regulated by the soil and climate which produced the vine; it is these factors which primarily determine the number of years required for a more or less perfect maturing of the Brandy.

Obscure Character of Flavours

BRANDY—Wines of the Cognac district of France yield a Brandy possessing the fine bouquet and other agreeable qualities for which true Cognac Brandy is remarkable.

Brandy is distilled wherever Wine is made from grape juice. Spain, Portugal and California produce large quantities. None of it, however, approaches in delicacy the Cognac Flavour;—the quality of the Brandy produced in other districts of France in all cases is inferior to that of Cognac Brandy.

There are at work in Nature's laboratory influences so subtle that man's skill cannot ensure that grapes of one quality, grown within a few hundred yards of one another, shall yield a Wine of equal merit.

A peculiarly striking example of this may be seen in the Claret-producing district of France. In some instances, Wine produced on one side of the road has a much higher value than that produced on the other, although the grapes are of the same variety and are grown under the same conditions.

RUM—The quality of Rum is ruled in a similar manner to Brandy. Just as Cognac is the district for producing the finest Brandy, so is Jamaica the country furnishing the choicest Rum.

The marked Flavours possessed both by Brandy and Rum are such that there are no grape substitutes or less costly material capable of producing a Spirit comparable with good Brandy; neither can the sugar-cane of the West Indies be replaced by anything which will produce fine quality Rum.

SCOTCH WHISKY—As the Cognac district is remarkable for Brandy, and Jamaica for Rum, so is the Glenlivet district in the Highlands of Scotland celebrated for the choicest Scotch Whisky.

Barley of the finest quality is made into Malt with water running from the heather-clad hills, dried in the kiln with peat dug in the neighbourhood; it is this combination which accounts for the choice flavour of Whisky produced in the Highlands of Scotland.

BRANDY, WHISKY and RUM—To summarise the foregoing, it is necessary to lay stress on the fact that

these Spirits are not merely mixtures of Alcohol, water and Flavours produced by the process of manufacture; they are the outcome of special products peculiar to certain districts which have become noted for their excellence. Long experience and observation have proved that these districts, by virtue of some subtle characteristics of soil and climate, yield raw material for which no substitutes of equal merit can be discovered elsewhere.

Says one of our greatest authorities on dietetics: "It is a profound mistake to regard Wine as a mere mixture of Alcohol and water. It is a complete living entity of which all the elements constitute an *ensemble* so complex and homogeneous that we cannot modify one or another without producing changes in the composition of the Wine itself."

Alcohol

Alcohol, as described by science, is "Pure Ethyl Alcohol—a transparent, colourless, mobile liquid, specific gravity 0·795, having a pleasant ethereal odour, very hygroscopic, mixing with water in all proportions."

Alcohol, combined with water, is the ordinary Spirit of commerce. According to the amount of Alcohol present, it is described either as Spirits of Wine, to be used by the chemist, or, if further diluted, it becomes the Plain or Neutral Spirit used for trade purposes.

This Spirit is produced from many kinds of grain, from potatoes, beetroot-molasses, and various other substances. The material from which it is produced, however, is unimportant, as the scientific methods adopted for its rectification are now so complete that all traces of its origin are removed.

When subjected to further rectification it is a tasteless Spirit known as "Spirits of Wine," specified in the *British Pharmacopœia*:—"*Spiritus Rectificatus*: Alcohol (90 per cent.). A liquid containing 90 parts by volume of ethyl-hydroxide C_2H_5OH, and 10 parts by volume of water, obtained by distillation of fermented saccharine liquids."

Toxic Action of Alcohol or Plain Spirit

Though the general belief is to the contrary, it is none the less true that chemically pure Spirit, used otherwise than as a drug in the hands of the doctor, is harmful.

With the view of determining whether the presence of immature flavouring compounds present in Spirit is responsible for the disagreeable effects resulting from drinking *new* Brandy, Whisky or Rum, experiments have been conducted with the tasteless Spirits of Wine used in medicine.

Spirits of Wine has been taken at certain periods in quantities equivalent to a moderate daily allowance of stimulant, and results carefully noted. Its action on the persons who drank it was quite as disagreeable as that attending the consumption of new Brandy, Whisky or Rum, if not more so. Spirits of Wine being, as already said, perfectly flavourless, this indicates that the principles which impart to Spirits their characteristic Flavours are not very active, and play no part in making new Spirit disagreeable.

The products of fermentation in certain selected materials are responsible for the subsequent wholesome qualities of the Spirit. This is evident from the fact that

plain rectified Spirit from whatever source, however long it may be kept, undergoes no useful change.

Chemically pure Spirit, like pure water, is unchangeable so long as neither of them hold any other body in solution.

Some authorities assert that the compounds produced in old Malt Spirit by oxidation and other changes act as correctives to the action of the Alcohol, much as atropine, the poison of belladonna, acts as a corrective to morphia, the narcotic principle of opium.

How important a part the Flavour of Spirit performs is shown by the fact that there are many persons who conscientiously affirm that they have never found Brandy of any description agree with them; others will say the same of Rum, and some also of Malt Whisky; yet either one of these may find one or other of these Spirits agreeable for their consumption, although the amount of Alcohol is the same in each.

It is generally accepted that moderate use of a well-matured Brandy or a Pure Malt Whisky of suitable age does not produce the objectionable symptoms which follow consumption of new or immature Spirit. Hence the importance of permitting Brandy, Whisky and Rum to mature, whereby the Flavours develop, as described on page 5.

Failure of Devices to Hasten Maturing

In the belief that the unwholesome quality of new Spirit is due to the presence of the undeveloped flavouring principle inherent to it, inventors have adopted a variety of methods for removing some of the more pronounced Flavours in new Brandy, Whisky and Rum, with the

view of making it softer to the taste, and at the same time hastening its development. These efforts have always proved fruitless.

Experience shows that any reduction of the natural Flavours in such Spirits as Brandy, Whisky or Rum more or less destroys their property for future improvement.

Ingredients for Producing Cheap Spirit

Where cheapness of production is desired, the cost of raw material influences the distiller in making selection. Spirit can be made from many substances which are much less costly, than the grapes employed for producing Brandy or than malt for Whisky.

It is obviously of great importance that Spirits for popular consumption should be prepared from those materials which, experience has proved, do produce a perfectly wholesome beverage.

In this respect Scotch Whisky calls for special remark, as it should be produced entirely from Malted Barley.

With Whisky, above all other Spirits, there is much more room for these economies which make for profit to the distiller, to the undoubted disadvantage of the consumer.

Malt

Malt is grain in which, by partial germination (arrested at the proper stage by heat), a specific ferment is produced which is capable, under certain conditions, of converting the starch into saccharine matter. The unfermented solution of the latter is the "sweetened wort" of the brewer.

The Process of Malting

The steps in the process of malting are four:—

(1st) *Steeping* in water from twenty-four to forty hours, by which the grain takes up from ten to thirty per cent. of water, swells, and begins to sprout or germinate.

(2nd) *Couching*, in which the steeped grain is piled in heaps on a floor, usually made of flag-stones, wherein the growth of the rootlets is aided by the heat generated in the mass.

(3rd) *Flooring*, in which the germinating grain is spread upon a floor in charges, called "floors," and stirred to expose it to air, and in which the growth of the rootlets is checked, and the germination of the sprouts or rudimentary stems * is carried to the desired limit.

(4th) *Drying*, in which the germination is completely arrested by heat in a malt kiln.

The length and appearance of the rudimentary stems tells the experienced malster when the conversion of the starch has been carried to the right limit.

The dried stems or sprouts and rootlets are broken off by handling in the kiln, and are removed by sifting. The chemical changes effected by the partial germination and subsequent treatment of the grain can only be described in technical language: they are chiefly *(a)* the conversion of the azotised substances into diastase; *(b)* the conversion of the starch into grape sugar by the action of the diastase, and *(c)* the imparting of colour and flavour to the malt in the kiln.

* Scientifically called "acrospires."

The malt is either pale or dark in colour, according to the degree of heat and the length of time it is exposed to heat in the kiln, and a peculiar flavour is derived from what is called empyreumatic oil, which is generated in the husk.

The importance of the exclusive use of malted barley in the preparation of Scotch Whisky is undeniable.

Malting essential for Whisky

The malting of barley sets up in the grain a chemical change obtainable by no other means; this is further continued by the heating it is subjected to in the kiln in completing the process.

This treatment is responsible for the Flavours which by age are resolved into the matchless qualities which distinguish an all-Malt Whisky.

The far-famed Spirit called Potheen Whisky, which was largely manufactured illicitly in the beginning of the nineteenth century, enjoyed so high a reputation that, as the vigilance of the authorities increased, and the Spirit grew scarcer, the price increased accordingly both for the Scotch and Irish productions. Being made from all-Malt, without any adulteration, this Potheen Whisky possessed a most agreeable Flavour.

The illicit distillers were users of all-Malt, as this means of producing the Spirit was the least difficult. Fear of detection and want of proper utensils induced adoption of the easiest method of production.

To such an extent was this distilling carried on that in 1806, out of the computed consumption of Spirit in Ireland in that year—viz., eleven million eight hundred thousand and thirty gallons—three million eight hundred

thousand gallons were admitted to be the produce of illicit manufacturers.

In 1811, 1812 and 1813 no fewer than nineteen thousand and sixty-seven illicit distilleries were destroyed in the United Kingdom by the Revenue Officers and the Military.

The employment of raw grain or other material, in entire or partial substitution for malt, results in a liquid containing less of the products which give liquor derived from Malt its character. Raw grain yields a Spirit which, owing to this deficiency, lacks the Flavour of all-Malt Whisky and will always possess many of the injurious properties of Neutral Spirit or Alcohol.

These injurious properties will not be ameliorated by time, however long the liquor may be stored; the reason being that the fault lay at the starting-point of fermentation.

It must be added that when a Plain Spirit is blended with an all-Malt Whisky, it is but a very poor compromise; for not only is the proportion of desirable compounds reduced by such addition, but mixing or blending spirits after distillation does not produce that absolute and complete combination between alcohol and flavour which is the case when both are the product of the same fermentation.

Just as it is "a profound mistake to regard Wine as a mere mixture of alcohol and water," so it is an equally profound mistake to regard Whisky or Brandy as simply Alcohol. The effect of Plain Spirit on the consumer is altogether different from that of matured Malt Spirit—*i.e.*, genuine Whisky. The former merely stimulates the action of the heart; the latter, in addition, braces the nerves and other vital centres. Thus, Plain Spirit might fail to restore a patient in a state of collapse, where a

matured Grape or Malt Spirit would succeed. This vital difference is due to the matured secondary products of the latter.

The harm attending consumption of Spirits which have been distilled from unsatisfactory sources and then rectified may be readily realised when it is stated that not only will such Spirits most certainly produce the injurious effect of simple Plain Spirit described on page 8, but may, from imperfect rectification, retain some of the objectionable constituents of the original fermented liquor.

It has been pointed out that of Whisky, Brandy, and Rum, the first is the one which is most capable of manipulation, or which can most readily be obtained from cheap and unsuitable raw materials; and the consumer who feels confident that by paying a suitable price he ensures that his Brandy shall be a Grape Spirit, and his Rum the product of the sugar-cane, must, if he values his health, take better means to secure that his Whisky is the yield of malted barley; for substitution and imitation in this case are more easily accomplished.

It may be worth notice that, apart from any of the previous considerations, a Pure Malt Whisky certainly promotes temperance to a degree greater than a Whisky deficient in Flavour can do. The neutral, tasteless Spirit added by the blender to new crude Whisky diminishes its coarseness, and thus disguising the potency of the Spirit gives a false impression as to its age. The absence of Flavour causes the consumer to mix much less water with his Spirit than he would if he drank a well-matured Pure Malt Whisky.

The agreeable full Flavour of the latter permits dilution to a much larger extent, without producing the insipid mixture which is made with the blended Spirit and water.

To briefly summarise the foregoing pages on Alcohol, it may be said—

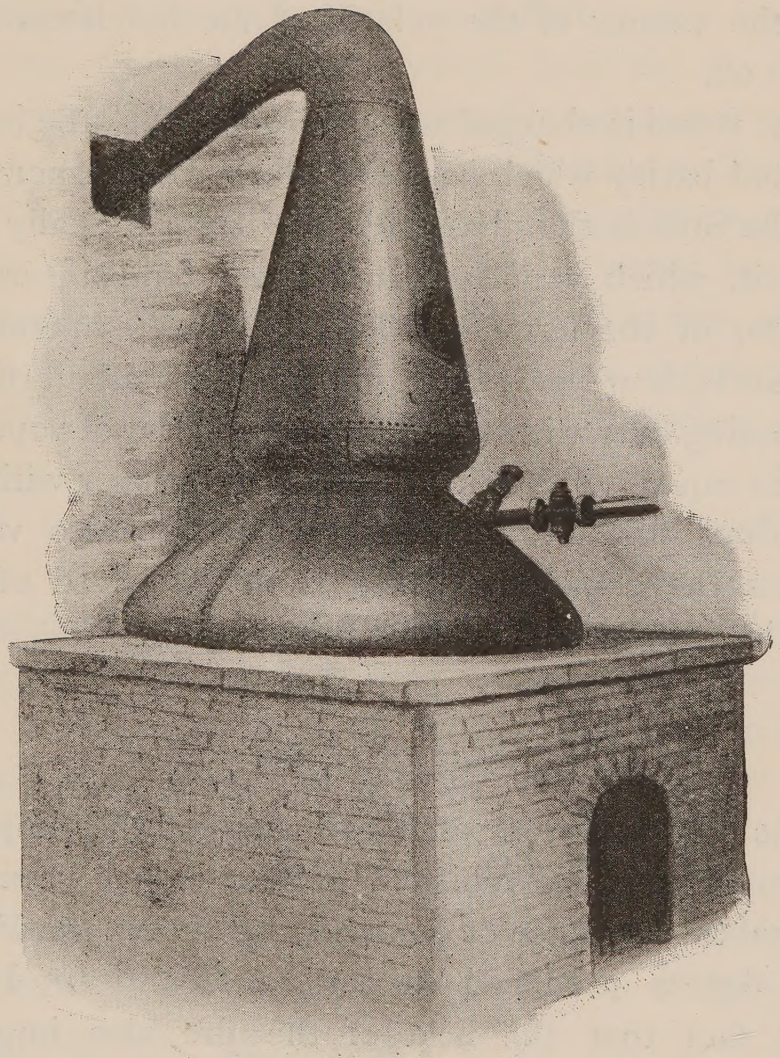
(1st) Alcohol is a product of alcoholic fermentation in saccharine solutions, and is separated by distillation.

(2nd) The general character of the Spirit is determined by the nature of the material from which it is produced.

(3rd) Grapes yield Brandy, Malt produces Whisky, Sugar-cane gives Rum. The Flavours produced by each of these materials are the only known means by which these Spirits become suitable for human consumption.

E
D
F
C
G
The great Still for Low Wines.
B
H
A A
The Worme out of the Tubb.
Let this Worm being set into the Wormtubb be so vpright not inclining to the right or left hand, but so ye water being put in it may run out to a drop.
AA the Ash hole;
B The Fire place;
C The body of the Still;
D the Head;
E the entry of the Crane neck;
F the joyning of ye nose thereof to the Worme;
G the Worme tubb;
H the Can;

A Pot Still of 1692



MODERN POT STILL

The Pot Still is of great antiquity; the date of its origin is doubtful.

On page 16 is an illustration taken from a book published in 1692, showing a Still similar to the Pot Still now in use, which is the only Still that should be used for the production of Pure Malt Whisky.

The Pot Still is a simple vessel, heated by a fire

below, entirely closed in except for an outlet at the top which communicates with the worm (or condenser) in which the vapour of the volatilised alcohol is condensed and run off.

The vessel is charged with the wash—*i.e.*, the infusion of malted barley which has been allowed to ferment—and when the Still is closed a gentle fire heat gradually expels the spirit, which vaporises at a lower temperature than the water of the fermented liquor. The temperature of the water is, however, raised sufficiently to admit of some of it passing over with the spirit in the form of vapour.

The vapour of Spirit and water carry over with them the various flavouring matters which are also volatile, and thus the condensed Spirit is not deprived of those properties it possessed in the mother-liquor.

Importance of Fire Heat

The Pot or Fire-heated Still has another important advantage in making Whisky. Reference has been made to the subtle influence of soil and climate on the Flavour of the Spirits produced in certain localities. It is a curious fact that the heat of the fire also imparts a Flavour to the vaporised matter. The fire heat gives the Spirit a character which distinguishes it from Spirits distilled by the Patent Still. It imparts to the Spirit the character known as empyreumatic, which is easily recognised in the product of the Pot Still and which is quite absent in Spirit produced by the Patent Still.

Patent Still and Method of Working

By the use of the Patent Still the production of Spirit is obtained in one operation, in place of the

intermittent system of repeated distillations required by the old method.

Rapidity is insured by introducing the wash in a small but constant stream, which finds its way through the apparatus; it is thus thoroughly exhausted of all its Spirit, and at the same time its purification is effected.

When Spirit is mixed with water it does not boil or rapidly vaporise until the mixture is heated to a mean temperature, depending upon the proportions of water and Spirit present; when that mean temperature is reached both water and Spirit vaporise together, and also the essential oils which may be present.

If, instead of immediately condensing such mixed vapour, it is allowed to diffuse itself in a chamber maintained at a temperature a few degrees above the boiling-point of Alcohol (173° Fahrenheit) nearly the whole of the water and oils will resume the liquid form, carrying with them but a small portion of the Spirit; and the Spirit vapour may then be drawn into another chamber at a lower temperature, where it will be condensed, this being repeated through the whole set of chambers. Spirit of high strength and in a state of very great purity will thus be obtained.

Commercial Value of Patent Spirit

This system of producing continuously Alcohol in a concentrated form effects great economies in its manufacture, particularly as it is capable of separating a nearly tasteless Spirit from almost any source. So efficiently does this apparatus do its work, that even the expert cannot with certainty distinguish from what material this neutral Spirit has been produced.

The blender who concerns himself only to produce a

palatable liquid from ingredients which cost the least is furnished by the Patent Still with what he knows as Silent or Grain Spirit; if used with a generous hand the crude productions of the Pot Still may be so softened down with Silent or Grain Spirit that even the blender congratulates himself on his skill.

The consumer must not consider the absence of flavour an indication of softness and age, as this want of taste can be produced by the addition of Silent or Grain Spirit, the yield of the Patent Still.

He should always be well assured the article he is consuming is the production which the label represents it to be.

APPENDIX

THE PATENT STILL—*see Plate, page 27*

The Patent Still, as the apparatus is generally known, was the result of long study and numerous experiments made by Mr. Coffey.

The ordinary form of Still employed before his device was perfected required repeated fractional distillation to separate the alcohol from the accompanying water. Consequently, many attempts were made to separate the two liquids by a continuous operation, without much success.

The Patent Office records a patent granted for Improvements in Distilling Apparatus to Æneas Coffey, of the Dock Distillery, Dublin, distiller, fifth day of August, in the first year of the reign of His Majesty King William IV., 1831.

This scientific apparatus of Mr. Coffey is usually constructed of rectangular frames of wood, about a foot in depth, and of the size proportioned to the quantity of wash required to be distilled in a given time. These frames are superimposed horizontally upon each other, until a column is formed rising to the height of from 20 to 30 feet. The apparatus may be arranged in one column; but, as a matter of convenience, it is generally formed into two, with a pipe to connect the top of the first with the bottom of the second. The first column is termed the "analyser" *(see plate)*, as in it the Spirit is separated from the wash; the second, the "rectifier" *(see plate)*, as in it the Spirit is purified and raised in strength.

The Analyser

Between the frames composing this column, diaphragms of copper plate are interposed, dividing the column into a series of chambers or compartments, from the bottom to the top. Those plates are pierced with numerous small holes, about one-tenth of an inch in diameter, and near one end of each plate a large tube is fitted, its upper edge rising about 1½ inches above the surface of the plate, and its lower end dipping into a shallow vessel placed upon the plate beneath. The tube in each plate is at the opposite extremity to that in the plate above.

The distillation is carried on by means of steam, at a pressure of 5 or 6 lbs. to the square inch, which is generated in an ordinary steam boiler, and being introduced into the bottom chamber of the column, rises successively into each of the other compartments through the perforations in the diaphragms; and from the top compartment it passes along the pipe to the rectifier.

When the "analyser" is under the full pressure of the steam, the wash is introduced into the top compartment, and is allowed to flow in a continuous current while the steam is kept up. As soon as the wash enters the column it is brought to a state of ebullition by the steam rushing through the perforations in the plates, and yields up part of the Spirit it contains. As the wash covers each plate in succession to the depth of the rim of the tube, it overflows through the tube to the plate below, encountering in each compartment fresh steam, and undergoing repeated distillation, until it reaches the bottom of the column, thoroughly exhausted of its Spirit.

From the lowest compartment the spent wash is discharged through a pipe bent like an inverted syphon,

which permits the constant flowing out of the wash, but prevents the escape of the steam which is entering the compartment by another pipe at the same time.

It is thus seen that, although apparently complicated, the operations in the "analyser" proceed upon the same principle as they do in the common Still; with perhaps this difference, that the impurities usually extracted from the wash with the last traces of Spirit, being in this apparatus separated in the lower compartments, have to pass through successive portions of wash in rising to the top of the column, and are to a great extent re-absorbed by the wash; the vapour which reaches the rectifier is therefore in a state almost free from Flavour as compared with the low wines vapour of the common Still.

The Rectifier

This column is constructed in the same manner as the analyser, and is also divided into numerous compartments by metal diaphragms; but the space enclosed by the five or six frames at the top is generally formed into one compartment, and the highest diaphragm in the series which forms the floor of this compartment is not perforated with small holes or furnished with a descending tube like the others, but has simply one large orifice, the edge of which is surrounded by a rim 3 inches in height. This diaphragm is termed the "Spirit plate," from its use, which is to collect the Spirit as it condenses into the liquid form in the chamber over it.

Commencing at the top of the column, a pipe of great length is carried in a horizontal direction through each compartment in succession. Entering the highest compartment it goes to the further end, bends, and returns to the outside of the column through the same

face as it entered; here it descends by a bend to the level of the next compartment, which it enters and travels through in the same manner as in the first; and so on to the last. Through this pipe, which is connected at the top with the wash charger or intermediate Still charger, the distiller can send wash or cold water at pleasure.

When the apparatus is in operation, the impure Spirit vapour from the top compartment of the first column or "analyser," passing through the pipe connecting the two columns, enters the bottom compartment of the "rectifier," and immediately comes into partial contact with the horizontal pipe through which is flowing liquor at a much lower temperature than the vapour. The consequence is that some of the watery and oily particles lose their heat to the extent of some degrees below the boiling-point of those bodies, and condense into the liquid form. The remaining vapour continues to ascend through the perforations in the diaphragms from chamber to chamber, encountering in each the pipe containing the descending liquor at a still lower temperature. Further condensation and elimination of the impurities therefore take place in each successive compartment; and before the vapour rises through the orifice in the "Spirit plate" it has been rectified or purified from all the impurities which distilled with it from the wash, except about 5 per cent. of water.

It thus appears that the second column or "rectifier" is as much an "analyser" as the first. The first separates the Spirit, along with water and oils, from the wash; the second separates the Spirit from the water and oils. They act, however, upon different principles; in the first, the heat communicated by the steam vaporises the Spirit; in the second, the gradual abstraction of heat until the

temperature of the vapour is just above the boiling-point of alcohol causes the liquefaction and separation of the water and oils from the Spirit.

When the purified vapour in the rectifying column rises above the "Spirit plate" it comes into contact with those sections of the liquor pipe through which cold water or wash is flowing, and is rapidly condensed into Spirit, which falls upon the "Spirit plate." From this plate the Spirit is immediately carried off by a pipe passing out of the column, and conducted through a vessel abundantly supplied with cold water, termed a "refrigerator," and thence through a close vessel with glass sides, termed the "safe," into the Spirit receiver, where it remains until the Revenue authorities measure it for the charge of duty.

The liquor which is sent through the pipe to act as a condenser in the chambers of the "rectifier" is, in the first instance, the *wash* on its way to the "analyser" to be distilled; when the wash is exhausted water is used.

As the wash in its progress through this pipe acquires the heat which is given up by the vapour in the chambers through which the pipe passes, it reaches a temperature of nearly 200° Fahrenheit before it leaves the lowest compartment of the "rectifier," and as the pipe is thence carried direct to the top compartment of the "analyser," the wash is discharged into that column within a few degrees of its boiling-point, and is thus prepared for immediate distillation, without any expenditure of fuel for that purpose.

In some "rectifiers" there is a distinct circulation of water pipes through the top compartment, in order to secure the condensation of the whole of the Spirit vapour. To guard against accidents from a sudden rush of vapour into the rectifying column, or the failure of the ordinary condensing and rectifying power, a large pipe, corresponding

to the "head" of a common Still, rises from the top of the column, and joins the feints pipes in the "refrigerator."

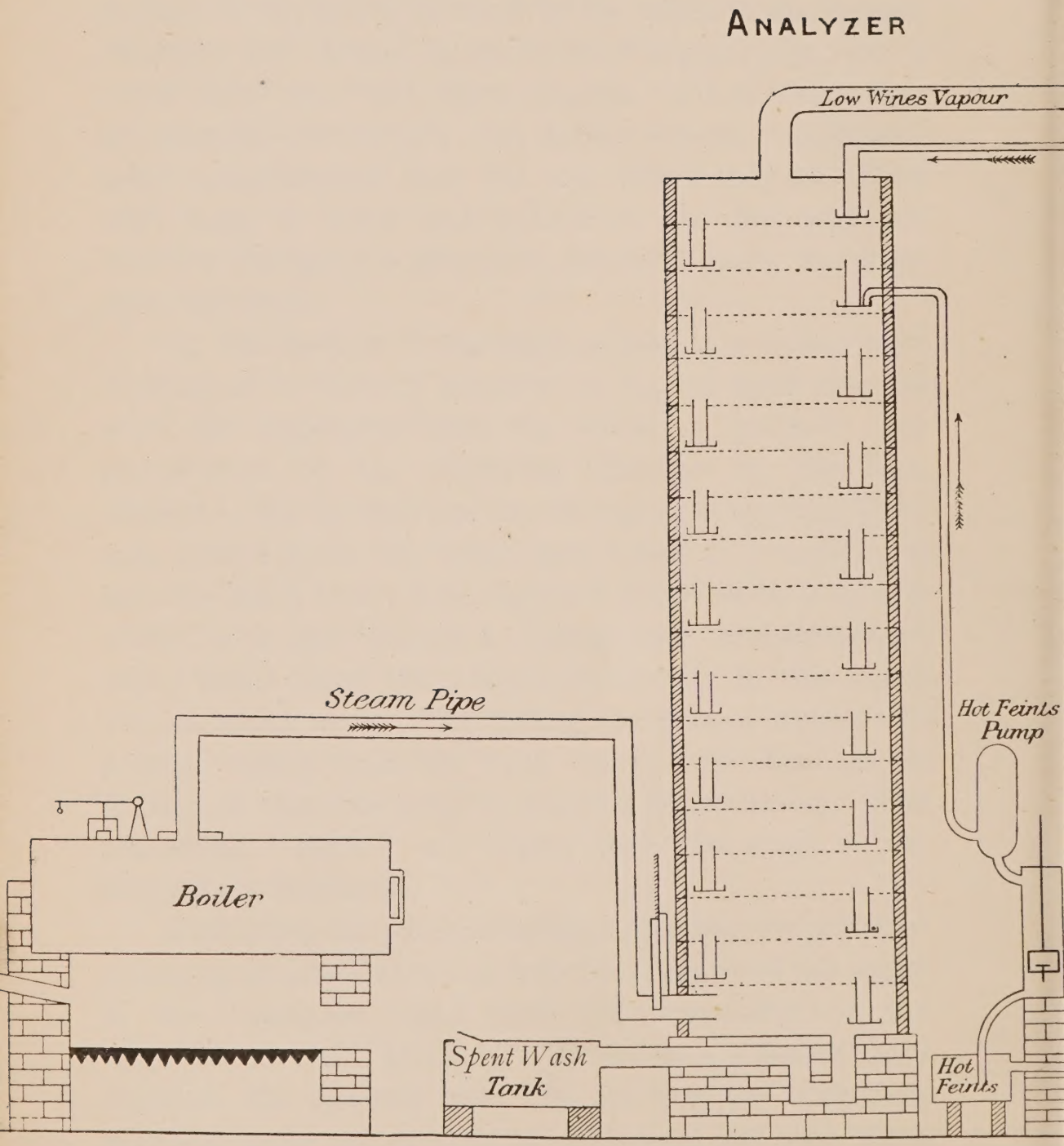
The water and oil, which have been liquefied in the lower chambers of the "rectifier" along with a small portion of the Spirit, descend by the tubes to the bottom chamber, and thence, by an inverted syphon pipe, into a vessel called the "hot feints receiver," out of which they are pumped continuously, and thrown into the "analyser," a few compartments from the top, where they are mixed with wash or water and redistilled. In this way the whole of the Spirit is ultimately obtained nearly free from taste and smell.

At the close of a distilling process it is found more economical to leave a quantity of impure Spirit than to work the apparatus until the whole is purified; the temperature of the rectifying chamber is, therefore, allowed to rise, so that any impure vapour containing Spirit may ascend above the Spirit plate before it is condensed into the liquid form; from thence it is carried by a branch of the Spirit pipe through a "refrigerator," and discharged into a vessel called the "feints receiver." In this vessel the oils which accumulate during the process separate to a large extent from the weak Spirit, and float on its surface, so that they may be removed by skimming. The remaining "feints" are mixed with the wash of the succeeding distillation.

In working the patent distilling apparatus the principal points to be attended to are (1st) the pressure of the steam in the "analyser," and (2nd) the temperature of the chambers in the "rectifier." As the two columns work together, the operator must also see that the operations going on in the one proceed at a uniform rate with those in the other.

The operator occupies a position upon a stage in front

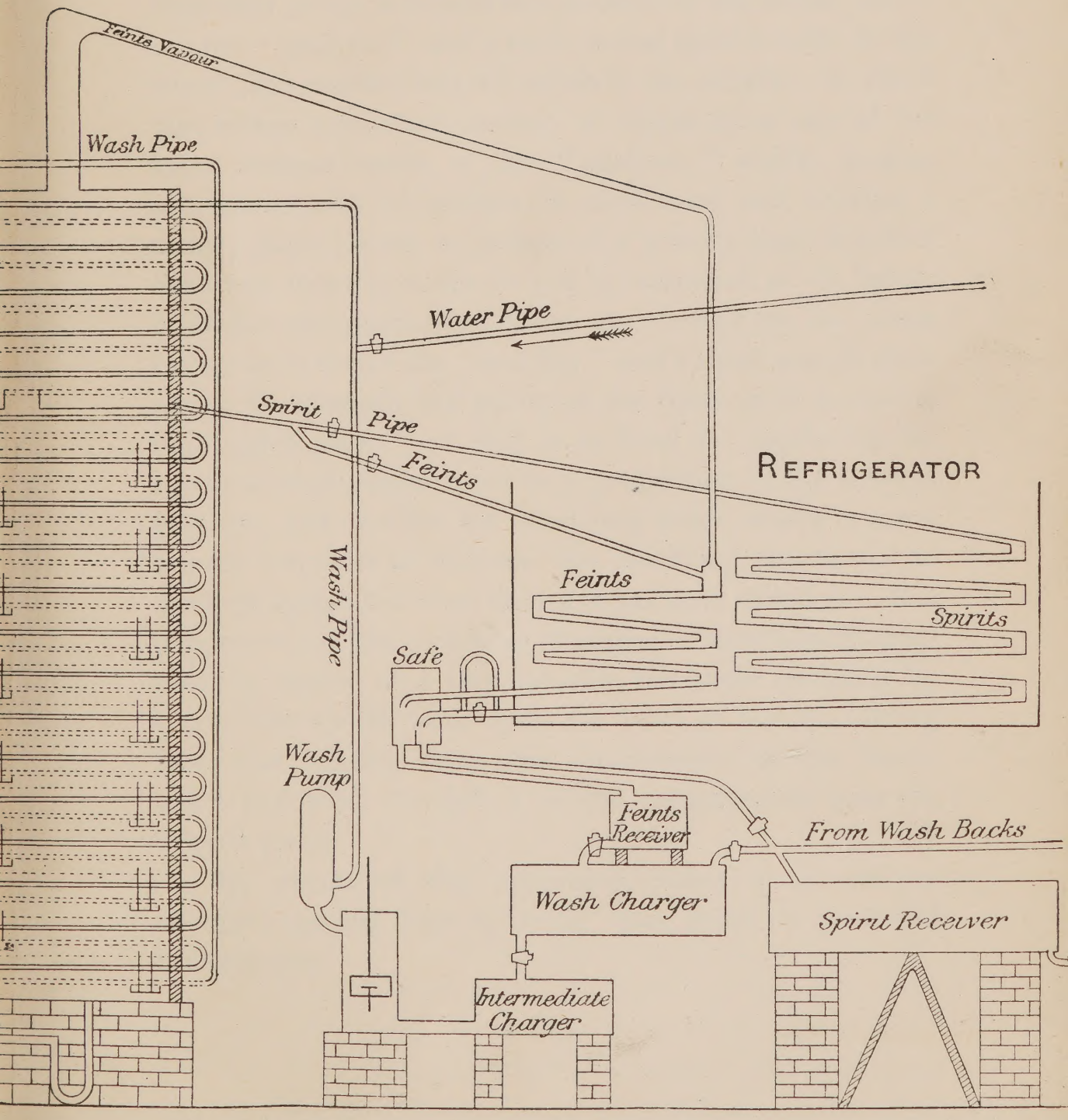
PATENT



VERTICAL SECTIO
WITH THE PRINCIPAL

STILL

RECTIFIER



COFFEY'S DISTILLING APPARATUS
AND VESSELS CONNECTED THEREWITH.

of the rectifying column, a little below the level of the Spirit plate; and near him are placed various contrivances for testing and regulating the action of both columns. A mercurial gauge indicates the pressure of the steam entering the "analyser," and a lever acting upon a valve in the steam pipe enables him to regulate the supply. A small pipe brings a constant current of vapour from one of the lower compartments of the "analyser," which, passing through a small refrigerator, is condensed, and entering a sample glass, shows, by means of a gravity bead, whether the wash about to make its exit is exhausted of its Spirit. A similar arrangement indicates the state of the low wines vapour as it enters the "rectifier," and a third sample glass shows the strength and purity of the Spirit as it is leaving the "Spirit plate." A cock is at hand for regulating the supply of wash, which must be in proportion to the amount of steam, and another for admitting water, which is occasionally required to increase the rectifying power, and to work the apparatus when the wash has been distilled. The temperature of the rectifying chambers is ascertained sometimes by means of a thermometer, but more generally by simply placing the hand upon the bend of the descending pipe, and judging from the temperature of the liquor which is flowing through it in the compartment near the "Spirit plate."

By means of this apparatus, Spirit at a uniform strength, ranging from 65° to 67° over proof, is produced continuously.

TERMS DENOTING STRENGTH OF SPIRIT

The various ways in which the strength of Spirits may be stated is rather confusing to anyone not familiar with the subject.

An alcoholic liquor is sometimes said to contain a percentage of Alcohol, or a percentage of Proof Spirit, or it may be described as being a certain number of degrees over or under proof.

Estimating Strength of Alcohol

The determination of the strength of an alcoholic liquid, or the estimation of the percentage of Alcohol any liquid may contain, is an operation of great importance.

Very laborious researches have, in consequence, been undertaken; and yet, even in the present day, the problem has not been altogether successfully solved.

Indeed, it is one so complex and so beset with difficulties that its complete solution appears well-nigh hopeless.

At the outset, we are met by the initial difficulty that pure dry Alcohol (absolute Alcohol as known to science) is a substance procurable only with extreme care and labour; in fact, this substance was perhaps never prepared till about a quarter of a century ago.

Even when procured, Alcohol rapidly becomes diluted with water when exposed to a damp atmosphere.

If Alcohol and water underwent no contraction when mixed, it would be comparatively easy to calculate by

well-known formulæ the percentage of Spirit present in any mixture.

Alcohol and water do, however, undergo contraction of volume when mixed, and it has, therefore, been necessary to ascertain directly the specific gravity of the two liquids when mixed together in all proportions and at different temperatures.

Analyst's Method of Determining the Percentage of Spirit

The Chemist always estimates the alcoholic value by ascertaining the exact quantity of absolute Alcohol in a spirituous liquid. This is invariably accomplished by determining the specific gravity of the mixture, with a view of being able to calculate the absolute Alcohol included in it.

Estimating Alcohol for Fiscal Purposes

The duties levied on Spirit are assessed according to the percentage of Alcohol, and hence the various Governments of different countries have from time to time sought the aid of men of science to assist them in determining the strength of Wines and Spirits.

In the latter part of the eighteenth century a scientific inquiry was undertaken by Blagden and Gilpin, on the application of the English Government: the results of their labours were published in the *Philosophical Transactions* for the years 1790, 1792 and 1794, and these results hold good, broadly speaking, until the present day.

The importance of readily discovering the real strength or percentage of Alcohol with expedition and

accuracy being recognised, various forms of Alcohol meters were constructed.

The one considered most practical is the instrument known as Sykes's hydrometer. This is the only one sanctioned by the Excise, and with it is calculated the duty now payable at the rate of eleven shillings per proof gallon upon all Spirits made in Great Britain.

This instrument does not at once note the specific gravity of the liquid, but the excess or deficiency of alcohol above or below a standard liquid called proof—a term which originated in a rude method of ascertaining the strength of Spirit by pouring it upon some gunpowder in a dish and igniting it. This was called the proof. If the gunpowder took fire, the alcoholic liquor was said to be above or over proof; but, on the other hand, if the powder did not take fire, the liquor was held below or under proof.

The gunpowder test, however, was quite uncertain as a means of showing the quantity of Spirit present in the liquid; for though the powder is ignited when a small portion of liquid is burnt, if a larger quantity be employed, so much water is formed that ignition of the powder is prevented.

By Parliamentary enactments the strength of Proof Spirit has been fixed, and is defined by Statute (58 Geo. III., c. 28) as "that which, at a temperature of 51° by Fahrenheit's thermometer, weighs exactly twelve-thirteenths of an equal measure of distilled water."

It is assumed, though not enacted, that the water is likewise at the temperature of 51° Fahr. Hence the specific gravity of Proof Spirit at 51° Fahr. is ·92308, when compared with water at the same temperature.

The liquors are estimated at the quantity of Spirit above or below this standard, as the case may be, and when a numeral is prefixed, it means the number of

volumes that are to be added to or substracted from a hundred volumes of the liquid, to bring it to standard or proof strength.

Thus twenty over proof means that a hundred volumes of liquor require the addition of twenty of water to bring them down to proof strength ; and when a liquid is twenty under proof, it is understood that twenty parts of water would have have to be abstracted before it would become proof strength.

Suggested Standard for Alcoholic Beverages

It here may be remarked that the Chemist and Analyst always records the percentage of Spirit present as "absolute Alcohol," whilst the Government standard is "proof."

The twenty per cent. over proof of the Revenue would be described by the Analyst as 68·5 per cent. by volume of absolute Alcohol, or one hundred and twenty per cent. of Proof Spirit under Excise regulations.

Although the former is the scientific method, and doubtless lends itself to accuracy when treating with abstract compounds, yet the adoption of the Government standard when describing the strength of any alcoholic beverage would be less misleading than the dual standard adopted—one by science and the other by commerce.

Works by SIR WALTER GILBEY, Bart., Published by Vinton & Co., London

Early Carriages and Roads

In this publication attention has been given to the early history of wheeled conveyances in England and their development up to recent times. With Seventeen Illustrations

SUMMARY OF CONTENTS.—Introduction.—First use of Wheeled Vehicles.—Badness of Early Roads.—Saxon Vehicles and Horse Litters.—Continental Carriages in the 13th and 14th Centuries.—Conveyances in Henry VI.'s Time.—"Chariots" First Used on Great Occasions.—First Use of Carriages; called Coaches.—Coaches in France.—Coaches First Used by Queen Elizabeth.—Duke of Brunswick, 1588, Forbids Use of Coaches.—The Stage Waggon.—The Introduction of Springs.—Steel Springs Introduced.—The First Hackney Coaches.—Excessive Number of Coaches in London.—Hackney Carriages and the Thames Watermen.—Hackney Carriages a Nuisance in London.—Licensed Hackney Carriages.—Coaches with "Boots."—Carriages in Hyde Park.—Coach and Cart Racing.—Regulations for Hackney Carriages.—Pepys on Carriages.—Glass Windows in Carriages.—Improvements in Carriages.—Pepys' Private Carriage.—Carriage Painting in Pepys' Day.—The First Stage Coaches.—Objections Raised to Stage Coaches.—Seventeenth Century High Roads.—Hackney Cabs as a Source of Revenue.—Manners of the Cabman.—Cab-driving a Lucrative Occupation.—Coaches and Roads in Queen Anne's Time.—Coaching in George I.'s and II.'s Reigns.—Dean Swift on Coaches and Drivers.—Roads in the 18th Century.—Speed of the 18th Century Stage Coach.—The Application of Springs.—Outside Passengers.—Roads in George III.'s Time.—Improvements in Stage Coaches.—The Mail Coach.—Regulations for Mail and Stage Coaches.—Mail Coach Parade on the King's Birthday.—The Mail Coachman and Guard.—"The Road" in Winter.—Passenger Fares.—Difference between Stage and Mail Coach. The "Golden Age" of Coaching.—Fast Coaches.—Heavy Taxation of Coaches.—Early Cabs.—Private and Stage Coaches, 1750-1830.—Varieties of Carriage.

Octavo, cloth, gilt, price 2s. net; post free, 2s. 4d.

Thoroughbred and Other Ponies

With Remarks on the Height of Racehorses since 1700. Being a Revised and Enlarged Edition of PONIES PAST AND PRESENT. With Ten Illustrations

SUMMARY OF CONTENTS.—Height of Early Racehorses.—Height of the Racehorse about A.D. 1800.—Height of the Modern Racehorse.—Height and Utility. I. In the Racehorse. II. In the Steeplechaser. III. In the Hunter and Saddle Horse. IV. In the Carriage Horse.—The Rate of Natural Growth.—Artificial Promotion of Growth.—Natural Promotion of Growth.—Control of Growth.—Possibility of applying Mr. Wilson's Methods.—Highest Vitality and Vigour accompany Normal Height.—Thoroughbred and Other Ponies.—Ponies of Early Britain.—New Forest Ponies.—Welsh Ponies.—Exmoor and Dartmoor Ponies.—Cumberland and Westmoreland Ponies.—Ireland—The Connemara Ponies.—Scotland—Ponies of the South; Highland Ponies; Shetland Ponies.—Arab Ponies.—Uses and Characteristics of the Pony.—Breeding Polo Ponies.

Octavo, cloth, gilt, price 5s. net; post free, 5s. 4d.

[OVER

Hunter Sires

Suggestions for Breeding Hunters, Troopers and General-Purpose Horses. By I. Sir WALTER GILBEY, Bart. II. CHARLES W. TINDALL. III. Right Hon. FREDERICK W. WRENCH. IV. W. T. TRENCH. A Review of the present condition of the Horse-Breeding industry in so far as saddle-horses are concerned, giving the views of some leading authorities on the methods whereby a breed of horses suitable for hunters may be established. Illustrated. Octavo, paper covers, 6d., post free, 7d.

Horse-breeding in England and India, and Army Horses Abroad

Seventeen Chapters, Horse-breeding in England; Eight Chapters, Horse-breeding Abroad; Thirteen pages, Horse-breeding in India. Nine Illustrations. Octavo, cloth, price 2s. net; post free, 2s. 3d.

Riding and Driving Horses, their Breeding and Rearing

An Address delivered in London on March 2, 1885, and Discussion thereon by the late Duke of Westminster, Earl Carrington, Sir Nigel Kingscote, the late Mr. Edmund Tattersall, and others. Reprint, 1901. Octavo, price 2s. net; post free, 2s. 3d.

The Great Horse or War Horse

From the Roman Invasion till its development into the Shire Horse. New and Revised Edition, 1899. Seventeen Illustrations. Octavo, cloth gilt, price 2s. net; post free, 2s. 3d.

Harness Horses

The scarcity of Carriage Horses and how to breed them. 3rd Edition. Twenty-one Chapters. Seven full-page Illustrations. Octavo, cloth gilt, price 2s. net; post free, 2s. 3d.

Young Race Horses—suggestions

for rearing, feeding and treatment. Twenty-two Chapters. With Frontispiece and Diagrams. Octavo, cloth gilt, price 2s. net; post free, 2s. 3d.

Small Horses in Warfare

Arguments in favour of their use for light cavalry and mounted infantry. Illustrated. Octavo, cloth gilt, price 2s. net; post free, 2s. 3d.

Ponies Past and Present

See Thoroughbred and Other Ponies

Horses Past and Present

A sketch of the History of the Horse in England from the earliest times. Nine Illustrations. Octavo, cloth gilt, price 2s. net; post free, 2s. 3d.

Animal Painters of England

from the year 1650. Illustrated. Two vols., quarto, cloth gilt, Two Guineas net. Prospectus free

Life of George Stubbs, R.A.

Ten Chapters. Twenty-six Illustrations and Head-pieces. Quarto, whole Morocco, gilt, £3 3s. net.

Poultry for Farmers and Cottagers

Being a practical treatise on the production of Poultry and Eggs for the Market. By Sir WALTER GILBEY, Bart. Illustrated. [*In the Press and will be published shortly*]

VINTON & CO., LTD.,

9, NEW BRIDGE STREET, LONDON, E.C.

PUBLICATIONS OF VINTON & CO.

DALMATIA ILLUSTRATA. 12s. 6d. net. By W. Royle.
ELEMENTS OF AGRICULTURAL LAW. 3s. 9d. By A. Pearce Higgins, M.A., LL.B.
ELEMENTS OF FARMING. Post Free, 2s. 9d. By Primrose McConnell.
ESSEX FOXHOUNDS. Illustrated. 25s. With Notes and full History.
FEEDS AND FEEDING. Post Free, 10s. By W. A. Henry.
FOOD OF CROPS AND HOW TO APPLY IT. Post Free, 2s. 3d. By C. M. Aikman, M.A., D.Sc.
FOX HUNTING: WHAT TO DO AND WHAT NOT TO DO. Post Free, 1s. 1d.
HINTS TO HUNTSMEN. Post Free, 1s. 1d. By Col. J. Anstruther Thomson.
HISTORY OF THE DEVON BREED OF CATTLE. Post Free, 10s. 9d. Edited by James Sinclair.
HOUSE SPARROW. In relation to Agriculture and Gardening. Post Free, 1s. 2d. By W. B. Tegetmeier, F.Z.S.
JERSEY CATTLE: THEIR FEEDING AND MANAGEMENT. 3s. 9d., Post Free
LAYS OF THE CHASE, AND ODDS AND ENDS. 2s. 6d. By Harry L.
LEAVES FROM A HUNTING DIARY IN ESSEX. 2 Vols., 3 guineas. By H. Beauchamp Yerburgh ("McAdam").
LETTERS ON WHIST. 1s., Post Free. By W. M. Deane, C.M.G., M.A.
LIGHT HORSES: Breeds and Management. Post Free, 3s. 10d.
LIVE STOCK JOURNAL ALMANAC. Over 350 pp. Half-bound, 2s.; by Post, 2s. 6d. Paper covers, 1s.; by Post, 1s. 4d.
LIVE STOCK JOURNAL SERVICE BOOK FOR ALL CLASSES OF STOCK. Price 1s. 6d., Post Free.
LIVE STOCK JOURNAL SERVICE BOOK FOR MARES. Price 1s. 6d., Post Free
LORD HENRY BENTINCK ON FOXHOUNDS. Post Free, 1s. 1d.
MANURING OF MARKET GARDEN CROPS. 1s., Post Free. By Dr. Bernard Dyer
MILCH GOATS AND THEIR MANAGEMENT. Illustrated. Post Free, 3s. 9d. By Bryan Hook.
NAMES FOR HOUNDS. Post Free, 2s.
NOTES ON THE RIFLE. Post Free, 5s. 4d. By Hon. T. F. Fremantle.
POLO. Illustrated. Post Free, 5s. 3d. By the late J. Moray Brown.
POLO. Price 15s. net, Post Free. By T. B. Drybrough.
PRACTICAL VETERINARY ADVICE. Post Free, 1s. 8d. By A. H. Archer.
SIDE-SADDLE RIDING. Cheap Edition, 3s. 9d., Post Free. By Eva Christy.
TALES OF PINK AND SILK. 6s. 3d., Post Free. By G. E. Collins.
VINTON'S AGRICULTURAL ALMANAC. By Post, 8d.; bound in cloth, 1s. 6d.

BOOKS FOR THE COUNTRY HOUSE

DRUID SPORTING LIBRARY. 5 vols., 3s. 6d. each; Post Free, 3s. 10d., or complete, 17s. 6d., Carriage Free. (1) The Post and the Paddock. (2) Silk and Scarlet. (3) Scott and Sebright. (4) Saddle and Sirloin. (5) Life and Times of "The Druid."
HALFORD DRY FLY SERIES. New and Cheaper Editions of Mr. Halford's Works. (1) Dry Fly Fishing; Fourth Edition; Price 10s. 6d. net; Former Price, 15s. (2) Dry Fly Entomology; Second Edition; Price 12s. 6d. net; Former Price, 25s. (3) Making a Fishery; Price 3s. 6d. net; Former Price, 7s. 6d. (4) An Angler's Autobiography (in the Press). Full Prospectus on application.
LIVE STOCK HANDBOOKS. 5 vols., Illustrated, 3s. 6d. each; Post Free, 3s. 10d.; or the Complete Set, 17s. 6d., Carriage Paid. (1) Sheep. (2) Light Horses. (3) Heavy Horses. (4) Cattle. (5) Pigs.
MORTON'S HANDBOOKS OF THE FARM. 2s. 6d. each vol.; or 10 vols., Carriage Free, £1 2s. 6d. (1) Chemistry of the Farm. (2) Live Stock. (3) The Crops. (4) The Soil. (5) Plant Life. (6) Equipment. (7) The Dairy. (8) Animal Life. (9) Labour. (10) Workmen's Technical Instructor.

Complete Catalogue Free on Application.

VINTON & CO., 9 New Bridge Street, Ludgate Circus, London, E.C.

[P.T.O.

BAILY'S
MAGAZINE OF SPORTS AND PASTIME

RACING, HUNTING, POLO, SHOOTING, YACHTING,
ROWING, FISHING, CRICKET

ESTABLISHED 1860

Of all Booksellers and Bookstalls, One Shilling. Or by Post direct f
the Office, 14s. per Year.

BAILY'S HUNTING DIRECTORY

ANNUALLY

Red Cloth, gilt lettered, 5s.; or by Post, 5s. 4d.

Gives information to Hunting men in search of a centre for Sp
throughout England, Wales, Ireland and Scotland.

LIVE STOCK JOURNAL

ILLUSTRATED

PUBLISHED FRIDAY. FOURPENCE

ESTABLISHED 1874

The only Paper in the United Kingdom wholly devoted to
Interests of Breeders and Owners of all varieties of Live Stock.

Subscription: 12 Months (including Special Summer Number), Post Free, £1:
3 Months, Post Free, 5s.; Foreign Subscription, £1 2s. per Year.

Specimen Copy Free.

AGRICULTURAL GAZETTE

ILLUSTRATED

PUBLISHED MONDAY. ONE PENNY

ESTABLISHED 1844

THE PRACTICAL FARMER'S PAPER

THE AGRICULTURAL GAZETTE is published at **ONE PENNY** per W
FOUR SHILLINGS and FOURPENCE per Year, or, by Post, **SIX SHILLIN**
and SIXPENCE per Year.

The GAZETTE gives sections dealing with all descriptions of cultivation of
land and live-stock management.

At the Bookstalls and Newsagents, One Penny.

Specimen Copy Free.